SPECIAL REPORT

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Outside Plant Must Evolve to Meet Bandwidth Growth

By Stephen Hardy

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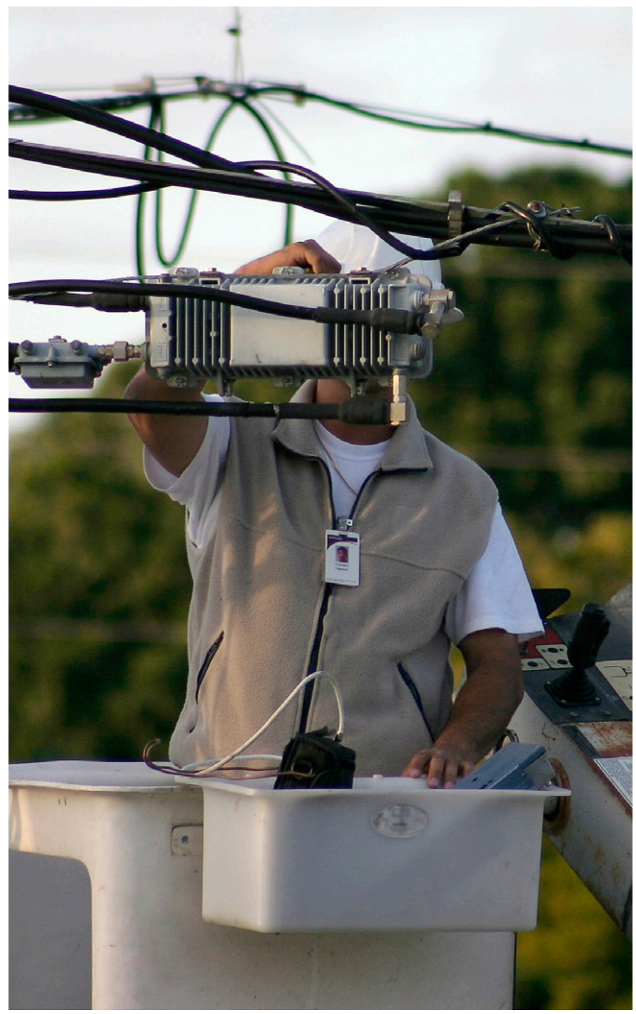
Outside Plant Must Evolve to Meet Bandwidth Growth

According to the most recent figures from the Leichtman Research Group, the top cable companies continue to outpace their telco competitors in broadband subscriber additions. Investments in new technology to increase bandwidth services delivery capacity and efficiency help explain this trend, with current CCAP and future DOCSIS 3.1 rollouts most often highlighted. However, the foundation for broadband and next-generation video services delivery – the outside plant – also must evolve to ensure these rollouts prove successful.



Regardless of the strategy in place to meet growing bandwidth requirements, operators must pay attention to the evolving demands placed on the outside plant.

Most of the innovation in hybrid fiber/coax (HFC) infrastructure lately has come on the fiber end, amplified by the increase in use of fiber to the premises (FTTP). However, even tried-and-true coax plant soon will be stretched in ways not seen previously.

Focus on Fiber

Clearly, manufacturers of fiber-optic cable would prefer to see FTTP replace HFC in as many markets as possible. Yet the advent of DOCSIS 3.1 also is good news for fiber, as cable operators will have to employ more fiber-deep network architectures to take full advantage of DOCSIS 3.1's benefits.

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Fiber/CaTV solutions

Regardless of whether the deployment focuses on FTTP or merely fiber deep, technicians will find that fiber continues to become easier to install and test. The transition to bend-tolerant single-mode fiber as standard for access network cables is pretty much complete across the supplier community. These fibers comply with one of two classes of ITU-T Recommendation G.657. Class A supports bend radii of 10 and 15 mm with a maximum bend loss at 1,550 nm of 0.75 dB and 0.025 dB/turn, respectively. For applications that require even greater bend tolerance, Class B offers maximum bend loss at 1,550 nm of 0.5 dB/turn at a 7.5-mm bend radius, and 0.1 dB/turn at a 10-mm radius.

Cable providers frequently use "bend tolerant" to describe Class A fiber-optic cables and "bend insensitive" as a label for cables that use Class B fiber. Either class offers significantly improved tolerance to loss from bending than the G.652.D fiber cables they are designed to replace.

Improved bend tolerance certainly helps fit new fiber into tight spaces. Cable manufacturers recently have introduced another innovation to help cram more fiber into congested conduit: cable with 200-micron fiber. As the term implies, 200-micron fiber uses a narrower coating width to create a diameter smaller than the 250 microns of standard single-mode fiber, which means you can either fit more fibers into the same cable width or produce narrower cables.

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Prysmian announced a 200-micron G.652 fiber in 2005, which eventually led to a 200-micron version of its bend-tolerant BendBright-XS fiber. OFS added its G.657.A1 AllWave *FLEX* in 2013; the company also makes the G.652-compatible 200-micron AllWave *FLEX*+. India's Sterlite Technologies (which also sells product in North America) unveiled its MICRO BOW LITE 200-micron fiber the same year, and Corning hopped aboard the bend-tolerant 200-micron train earlier this year with its SMF-28 Ultra 200. So operators can now buy such narrower cabling with bend-tolerant fibers from numerous suppliers.

Given the variety of fiber types described here, operators could find themselves with something of an inventory problem. Fiber manufacturers have attempted to ease this burden by combining the properties normally associated with different applications to create multi-use fiber and cabling. For example, a new class of fiber combines low attenuation for higher-bandwidth metro applications with the bend tolerance of access networks to create fiber-optic cable that can be used for both requirements. Corning's SMF-28 Ultra and the AllWave One fiber from OFS offer examples of this trend.

This drive for multi-application technology for fibered outside plant extends beyond the cabling. For example, recent months have seen the introduction of fiber distribution hubs that can be used in both above-ground and underground scenarios.

Testing time for coax

While fiber-optic technology appears to be constantly in flux, coaxial cable technology has remained stable. Much of the recent innovation focus for coax has centered on how to ensure proper deployment of DOCSIS 3.1 to support downstream capacity of 10 Gbps and upstream capacity of around 1 Gbps.

The fundamental differences between DOCSIS 3.1 and DOCSIS 3.0 include:

:: The use of higher downstream frequencies, including 1.216 GHz now and 1.794 GHz in the future

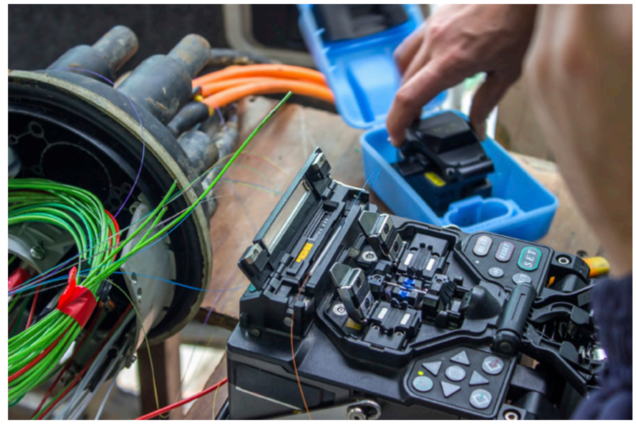
:: The use of orthogonal frequency division multiplexing (OFDM)

:: Support of downstream channels as wide as 192 MHz

:: A switch from Reed-Solomon forward error correction to Low Density Parity Check (LDPC).

DOCSIS 3.1 also features a Proactive Network Maintenance (PNM) capability. PNM enables DOCSIS 3.1 CMTS and CPE systems to treat a variety of transmission impairments automatically. This ability certainly makes life easier for the operator and network technicians – but doesn't entirely remove their burden, particularly when it comes to the physical plant.

It's no wonder then that Jorge Salinger, Comcast's vice president of access architecture, told the audience at BTR's "DOCSIS 3.1 Revisited" breakfast panel that access to the proper tools would gate his company's DOCSIS 3.1 deployment schedule. Test equipment vendors have raced to fill this void, with the first systems for field use making their debut at SCTE Cable-Tec Expo this past October.



Fiber remains expensive to install all the way to the customer. But prices are decreasing as installation speeds increase.

The use of OFDM presents the trickiest challenges, sources in the vendor community say. Modulation error ratio (MER) and bit error ratio (BER) measurements in particular become more complicated, given the larger number of subcarriers in DOCSIS 3.1 and the resultant variance in modulation and FEC rate combinations. The simplest way to make such measurements would be to calculate the minimum, maximum, and average MER and BER values across a channel. But simple isn't always better, and this approach likely would fail to detect impairments that affected only a few subcarriers or a small frequency range within the channel under test, sources say.

A better approach, according to some vendors, is to calculate equalizer stress, in-channel response, group delay, and other parameters and display them in a way that makes sense. Automation of these calculations naturally would ease the technician's life as well.

Initial attempts to follow this philosophy are about to reach the field. They include the ability to scan and provide spectral analysis of both OFDM and physical link channels as well as measure the performance of uplink transmissions.

Of course, it would be most economical if these new test capabilities didn't require brand new test instruments. While the market has seen the introduction of new instruments that include DOCSIS 3.1 capabilities, some vendors have touted the ability to upgrade already fielded systems with the necessary capabilities.

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Further measurements

Fiber test, of course, becomes more important as DOCSIS 3.1 rolls out as well. Again, increased automation is a key strategy that test and measurement vendors have pursued to help make optical communications testing easier and more efficient, as well as lower in cost.

In this last vein, test equipment vendors have sought to lower costs by combining multiple test functions into the same instrument. The use of mix and match modules that technicians can insert into a host instrument serves as the most common strategy toward such flexibility; in fact, some platforms can accept modules that will support either optical or coax infrastructure tests. However, vendors also have begun to add a level of automation to this process through the use of software programming. In some instances, the necessary control or enablement of individual test instrument features can reside in the cloud.

The use of smaller platforms for such instruments, including tablets and, in some instances, smartphones has emerged as a trend thanks to such programmability. Software-based strategies also enable remote testing capabilities, such as optical time-domain reflectometer (OTDR) measurements, via small, simple instruments.

Preparing the way

Regardless of whether a particular market will see FTTP, DOCSIS 3.1, or both, operators will ignore the requirements of the physical plant at their peril. An increase in the use of fiber obviously carries potential changes and challenges for technicians. But even familiar coax links will need a fresh look as DOCSIS 3.1 roll outs begin and enhanced services reach the customer premises.

Fiber technology continues to evolve to make deployments easier, faster, and more economical. Of course, nothing is more economical than leaving infrastructure, such as existing coax networks, in place. Regardless, new test tools promise to help operators care for their physical plant while they're caring for their customers' increasing bandwidth demands.

Stephen Hardy is editorial director of Broadband Technology Report.